

Novel Non-Intrusive Vibration Monitoring System for Turbopumps, Phase I

Completed Technology Project (2005 - 2005)



Project Introduction

AI Signal Research, Inc. proposes to develop a Non-Intrusive Vibration Measurement System (NI-VMS) for turbopumps which will provide effective on-board/off-board fault detection diagnostic capabilities without relying on any intrusive installation of once per revolution (1/Rev) tachometer key phasor measurement. Many vibration signature analysis techniques use a key phasor signal to identify and detect critical vibration characteristics and fault signatures. However, in many operational environments (e.g., SSME HPOTP), the tachometer measurement is not available usually due to its intrusive installation requirement or safety consideration. For this situation, many powerful diagnostic analyses cannot be performed. With our system, we overcome this problem by utilizing a novel signal analysis technique called Pseudo Key Phasor (PKP) to reconstruct an equivalent 1/Rev PKP signal directly from a non-intrusive vibration measurement. The resulting PKP signal enables the use of effective signature analysis to enhance diagnostic capabilities. The applicable innovation is attributed to effectively achieve non-intrusive health monitoring and diagnosis without intrusive tachometer installation. This technology will enhance incipient fault detection capability, reducing catastrophic engine failure risks and improve reliability of NASA's advanced propulsion systems. Phase I objectives are to demonstrate the feasibility and relative benefits of NI-VMS non-intrusive monitoring capabilities.

Anticipated Benefits

A low-cost non-intrusive engine vibration monitoring system has strong Non-NASA commercial application. The commercial transportation and power generation industries will benefit from its availability as will the manufacturing sector where production lines frequently rely on critical, active machinery. In particular, many commercial aircraft engines are not instrumented with a 1/rev tachometer. Implementing an effective non-intrusive health monitoring system in these commercial transport aircraft fleets will reduce the risks of catastrophic hardware losses and down time.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

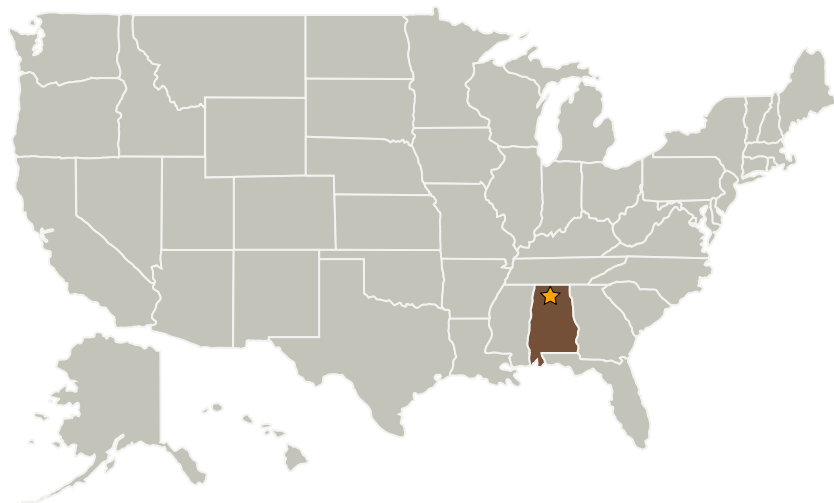
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
AI Signal Research, Inc.	Supporting Organization	Industry Minority-Owned Business	Huntsville, Alabama

Primary U.S. Work Locations

Alabama

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Tony R Fiorucci

Principal Investigator:

Jen-yi Jong

Technology Areas

Primary:

- TX10 Autonomous Systems
 - └ TX10.2 Reasoning and Acting
 - └ TX10.2.5 Fault Diagnosis and Prognosis